### Moon and Gravity Information

**SC.K.E.5.1** Explore the Law of Gravity by investigating how objects are pulled toward the ground unless something holds them up.

|  |  |
| --- | --- |
| Science Video - [**High Bounce**](http://thehappyscientist.com/science-video/high-bounce) | Science Video - [**Water in a Glass, part 1**](http://thehappyscientist.com/science-video/water-glass-part-1) |
| Science Video - [**More Science of Balance**](http://thehappyscientist.com/science-video/more-science-balance) | Science Video - [**Water in a Glass, Part 2**](http://thehappyscientist.com/science-video/water-glass-part-2) |
| Science Video - [**The Science of Balance**](http://thehappyscientist.com/science-video/science-balance) | Science Experiment - [**Rock Stacking**](http://thehappyscientist.com/science-experiment/rock-stacking) |

The High Bounce

This time, we will explore the ways that energy can be changed from one form to another. Be sure to try this science experiment outside! That will save you the work of cleaning up the pieces of broken lamps and shattered windows.

You will need:

* a basketball or soccer ball
* a tennis ball
* duct or masking tape
* a flat, hard surface, outside

Hold the basket ball about shoulder high in one hand and the tennis ball at the same height with the other. Drop both at the same time. If both are fairly new and fully inflated, they should bounce about the same height. OK, nothing strange about that.  
  
Next, use the tape to make a round, raised collar on the basketball. This is going to help you balance the tennis ball on top of the basketball. It does not have to be fancy. Just a ridge of tape in a circle that will fit the bottom of the tennis ball.  
  
Hold the basketball out at the same height as before, with the tape ring at the top. Place the tennis ball into the tape ring. It should balance there. Now, before you drop it, think about what you expect to happen. Then drop the balls.

Understanding the Science

What happened? The tennis ball bounced VERY high. Why did that happen?  
  
When you were holding the basketball and the tennis ball, they had potential energy, the energy of position. When you released them, that potential energy was changed into the energy of motion. In other words, they fell. When the basketball hit the ground, its momentum compressed it, flattening the bottom. The same thing happened when the tennis ball hit the basketball. Their energy of motion was changed into compressed mechanical energy, much like squeezing a spring.  
  
Then the compressed mechanical energy was changed back into the energy of motion. As the basket ball bounced, it bumped into the tennis. That impact transferred some of the energy of motion from the basketball to the tennis ball. The basketball was left with less energy of motion, so it did not bounce as high as it did the first time. The tennis ball wound up with a lot more energy of motion, so it bounced very high.  
  
What do you think would happen if you reversed the two balls, putting the basketball on the top? How much higher would the extra energy from the tennis ball lift it. What if you used a heavier ball instead of the basketball? Or a ping pong ball on the top? There are all sorts of combinations to try, and you will be surprised how much you learn while you are having fun.

Objects in the sky move in regular and predictable patterns. As a basis for understanding this concept:

Students know the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.

Students know the way in which the Moon's appearance changes during the four-week lunar cycle.

Students know telescopes magnify the appearance of some distant objects in the sky, including the Moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than the number that can be seen by the unaided eye.

Students know that Earth is one of several planets that orbit the Sun and that the Moon orbits Earth.

**Does the Moon rotate?**

Excellent! Yes, the Moon rotates as it orbits the Earth, at just the right speed so that the same side of the Moon is always facing us. This is not unusual. Almost all of the moons in the solar system do the same thing, always presenting the same side towards the planet that they orbit.

Be a little careful . . . the Moon does rotate. If you stood on the Moon, the stars would rise and set, just like they do on Earth, except that a lunar day is a month long, the same as the Moon's orbital period. The Moon rotates at just the right speed so that it always keeps one face pointed toward the Earth, which seems like a pretty big coincidence, doesn't it?

Yes, it does, but as fast as it turns around our planet (it takes the moon 28 days to turn around Earth, and 28 days to rotate on itself). That's why we only see one side of it.

**S4E2. Students will model the position and motion of the earth in the solar system and will explain the role of relative position and motion in determining sequence of the phases of the moon.**

a. Explain the day/night cycle of the earth using a model.

[Video: Global Science](http://thehappyscientist.com/science-video/global-science)

b. Explain the sequence of the phases of the moon.

c. Demonstrate the revolution of the earth around the sun and the earth’s tilt to explain the seasonal changes.

[Video: Global Science](http://thehappyscientist.com/science-video/global-science)

d. Demonstrate the relative size and order from the sun of the planets in the solar system.

[Video: Planets And Pennies](http://thehappyscientist.com/science-video/planets-and-pennies)  
[Experiment: Scale Model Of A Solar System](http://thehappyscientist.com/science-experiment/scale-model-solar-system)  
[Video: Global Science](http://thehappyscientist.com/science-video/global-science)

**[](http://thehappyscientist.com/blog/science-photo-day-280)**

### If you stood on the Moon, holding a feather and a lead weight, and dropped them both at the same time, what would happen?

Good job! They would both fall, and hit the ground at the same time. The Moon's gravity is only about 1/6 of Earth's, so they would not accelerate as quickly as on Earth. There is not enough of an atmosphere on the Moon (but it does have an atmosphere!) to provide significant air resistance to the feather, so it would fall just as fast as the lead weight.

The lead weight and the feather would both fall to the surface of the moon and hit at the same time, because the moon has no atmosphere to slow down the feather.

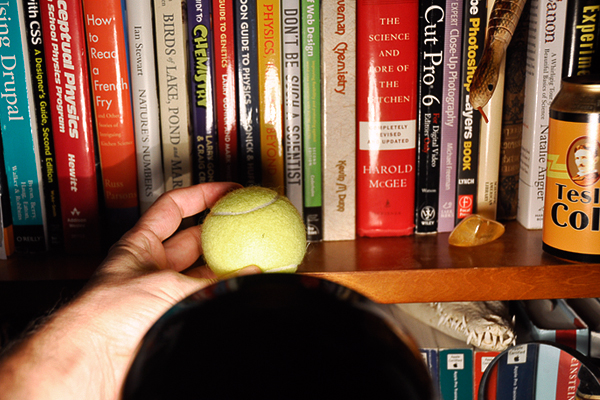
## [**Why is a Full Moon So Bright?**](http://thehappyscientist.com/science-experiment/why-full-moon-so-bright)

Members:



Have you ever been outside on a clear night, when there was a full moon? If so, you probably noticed that it was incredibly bright, almost ten time brighter than a half moon. How can that be? Shouldn't a half moon be half as bright as a full moon? To find out, you will need:

* a ball, or some other round object
* a lamp or flashlight





The lamp will simulate the Sun, and the ball will simulate the moon. You are going to be the Earth. Lets start with a full moon. Darken the room by turning off the lights, and closing the window shades. Turn on the lamp, and sit with your back to it. Hold the ball out in front of you, so the entire surface of the ball seems well lit. This is how the moon is positioned during a full moon, on the opposite side of the Earth from the Sun. Notice how the light from the Sun (the lamp) is reflecting off the moon (the ball) back to you, making it look very bright.

OK, now lets switch to a half moon, also known as either a first quarter moon or a third quarter moon. To see that, turn in your chair so that the Sun (the lamp) is directly to your left. Again, hold the ball out in front of you. The side of the ball that faces the lamp is still fully lit, but you can only see half of it. The side of the ball that is away from the lamp is dark, and you can see half of that. It should look much like the photograph of the half moon.

Notice that even the lighted part of the ball is not as bright as it was when you simulated the full moon. That is because most of the light is still reflecting back towards the lamp, just as it was before. The difference is that you are not between the lamp and the ball, so that reflected light is not coming towards you.

If you want to compare the actual brightness of the different phases of the moon, do an internet search for "printable eye chart", or make your own. It should have very large letters at the top, and they should get smaller as you go down the page. Print that page, and find a place outside where there are no lights shining on you except for the moon. Notice what phase it is in, and then see how far down the chart you can read, using moonlight for illumination. On a clear night, with a full moon, you should be able to read several of the top lines of letters. A week later, at the half moon, try it again. Be sure that the moon is about the same height in the sky. You will find that it is much harder to see the letters, because there is much less light. You might even try it every night, to see how much it changes from day to day. Does it change the same amount every day? Can you figure out why? Might make a good science fair project.

**Science Photo of the Day #524**

**[](http://thehappyscientist.com/blog/science-photo-day-524)**

**This weekend is the "supermoon". Will it be noticeably bigger or brighter than usual?**

Yes, the "Super Moon" looks bigger and brighter than usual, but not nearly what most of the coverage portrayed. This month's full moon is only 1/2 of one percent larger than last month's full moon. Every month the moon has an apogee (when it is farther from Earth) and a perigee (when it is nearer the Earth.) Every month, there is about about a 15% difference in the apparent size and about a 30% difference in the apparent brightness of the moon. This month, the perigee was a little closer than usual, but not enough to cause a noticeable difference from any other full moon near perigee. The moon on the left is the size of this full moon compared to last month's full moon on the right.



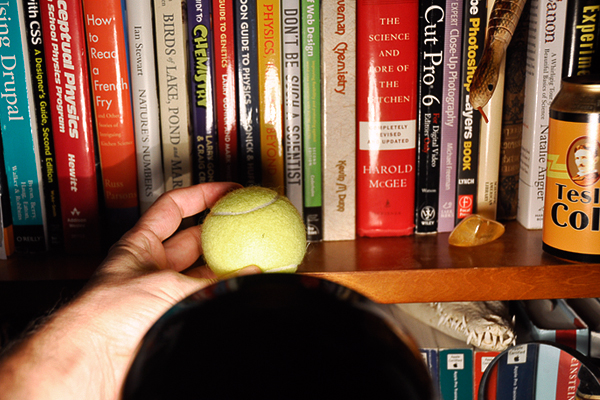
**SC.4.E.5.2** Describe the changes in the observable shape of the moon over the course of about a month.

Have you ever noticed that the moon seems to change its shape. Some nights, it will be entirely lit up, which we call a full moon. Other nights, it may be half light, and half dark, while still other nights, it may be almost totally dark.



Why does it change? To find out, you will need:

* a ball, or some other round object
* a lamp or flashlight
* a chair that swivels or can be turned
* someone or something to hold the ball





To see why the moon seems to change, we are going to pretend that the lamp is the Sun, and the ball is the moon. You get to be the Earth.

Lets start with a full moon. Darken the room by turning off the lights, and closing the window shades. Turn on the lamp, and sit with your back to it. Have someone hold the ball in front of you, and notice that the entire surface of the ball seems well lit. This is how the moon is positioned during a full moon, on the opposite side of the Earth from the Sun. Turn your chair to the left. This simulates the rotation of the Earth, and one full turn will simulate one day. Notice that as you turn, the moon is still fully lit.

OK, now lets move ahead in time one week to a third quarter moon. To see that, face away from the light again and have the person holding the ball to move to stand your left side, about the same distance away. Slowly rotate your chair to the left, and notice how the "moon" looks now. The side of the ball that faces the lamp is still fully lit, but you can only see half of it. The side of the ball that is away from the lamp is dark, and you can see half of that. It should look much like the photograph of the half moon.

One week later, the moon would be between the Earth and the sun. To simulate that, have the person holding the ball to move it directly between your chair and the lamp. Again turn your chair in a circle to the left. The side of the ball that you can see is all dark. That is known as a new moon.

Can you guess what comes next? Right. Face away from the lamp and have the person holding the ball move to your right side, again staying about the same distance. Rotate your chair to the left again, and watch the moon. Again, half of what you can see is lit, and half is dark, but they are reversed. With the third quarter moon, the left side of the ball was lit. Now we have a first quarter moon, and the right side of the ball is lit.

One week later, the moon would be back to its starting place as a full moon.

**For additional information on this benchmark:**

**SC.4.E.5.2** Describe the changes in the observable shape of the moon over the course of about a month.

**Scale Model of the Solar System**

Here is an easy way to get an idea of how large our solar system really is. To try this, you will need:

- one standard 240 sheet roll of toilet tissue  
- a large area

We will start at the center, with the sun, which in our model is about the size of your thumbnail. Then we will use the tissue as a measuring tool. Starting from the sun, if you unroll two sheets, you have reached the orbit of Mercury. Each sheet of tissue represents about 25 million kilometers, and the orbit of Mercury is about 57,900,000 kilometers from the sun, which puts us just a hair past 2 sheets. If you want to add the planet Mercury to your model, use a very fine pencil point to make a tiny dot. That dot is still too big, but it will do for our purposes.

Unroll two more sheets and you get to the orbit of Venus, 108,100,000 kilometers from the sun. Again, you can add Venus by making another very tiny dot. Again, the scale model of Venus would be smaller than your dot.

Unroll two more sheets and you get to the Earth, at 149,500,000 kilometers. Another tiny dot goes here.

To get to the orbit of Mars, unroll three more sheets, which puts us at 227,800,000 kilometers. One more tiny dot will represent Mars.

Next in line is the orbit of planet Jupiter. To get to Jupiter, unroll 21 more sheets, for a total of 30 sheets from the sun. The orbit of Jupiter is 778,000,000 kilometers from the Sun. This time we can make a bigger dot, about .07 centimeters if you have a metric ruler.

From Jupiter to the orbit of Saturn, unroll 30 more sheets, and make a dot about .06 centimeters. At this point, we are 1,427,000,000 kilometers from the Sun.

After Saturn, the next orbit is Uranus, and we will need 60 more sheets to get there, for a total of 120 sheets from the sun, 2,869,000,000 kilometers. Here, we go back to making the tiniest dot that you can.

From the orbit of Uranus to the orbit of Neptune, unroll 60 more sheets, representing 4,497,000,000 kilometers from the Sun, and make another tiny dot.

60 more sheets will take us to the orbit of Pluto, 5,900,000,000 kilometers from the Sun. You would need a microscope to see a dot that was the proper scaled size for Pluto in our model.

Now look back over your solar system. Look at all the open space, and the tiny planets. Think that is a lot of open space? Maybe you want to add in the nearest star, Proxima Centauri. It is only 4.2 light years away, a mere 38,000,000,000,000 kilometers away. To do that, you would need 6334 rolls of toilet tissue, just over 96 miles of tissue, and that is just to the closest star. That vast amount of space requires some thought, which for me involves some ice cream to fill some of the empty space inside me.